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A CONVERSATION ON INSTRUCTIONAL DESIGN WITH ROBERT GAGNÉ AND DAVID MERRILL NO:1

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Abstract:
The purpose of the study is to bring in the first part of diachronic conversation on instructional design with Robert Gagné and David Merrill to transcripts. This conversation was hosted by Utah State University, in the United States of America, in July 10, 1989. Throughout the history of instructional design, these two scientists are considered as the pioneers of the field and in these sessions, they summarize and compare their studies. In the first session, Gagné and Merrill represent their theories from their own perspectives.

Keywords: Gagné, Merrill, Conversation, Instructional design

1. Instruction

Robert Gagné was the most important name in the field of instructional design area. He followed by many researchers and scientists. Like David Merrill ve Charles Reigeluth. Merrill's Component Display Theory, Reigeluth's Elaboration Theory have some marks from Gagné s work. Utah State Univerisity hosted a conversation on instructional design with Doctor Robert Gagné and Doctor M. David in July 10, 1989.

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2. Method

Conversation videos are not commercial. Utah State University made open acccess to find them at https://archive.org/details/ConvInstDesign. So those videos were dowloaded. Transcripts were created.

3. Findings

Don Smellie: "I am Don Smellie, professor of education and head to the Instructional Technology department at Utah State University. Recently we hosted a conversation on instructional design with Doctor Robert Gagné from Florida State University and Doctor M. David Merrill at Utah State University. Now, neither of these individuals needs an introduction Doctor Gagne is among the most prominent names in our field and considered by many as the father of instructional design as we know it today. Objectives, hierarchies, and the conditions of learning form the theoretical foundation upon which many have built in designing and developing instructional products. Doctor Merrill has based much of his efforts on Doctor Gagné's work. He has elaborated areas which he felt needed more detail. Component display theory and elaboration theory are recognized as major contributions to the field of instructional technology. Together Doctor Gagné and Doctor Merrill represent fundamental theoretical focal points upon which much of what we know about instructional design is based. These two prominent theorists have cooperated and shared their views before but never before in such a lasting and personal way as you are about to see. This is a video transcription with minimal editing. It is not a commercial studio production but a working transcription of the live proceedings. You should have also received a graphics package which contains the visuals used with other supporting materials that were distributed during the conference. As you will see the agenda acted as a guide rather than a blueprint. Now don't be alarmed that many have the graphics and agenda items are not mentioned are used during the discussion. We are richly rewarded by the content that they choose to address. In this first session, Doctor Gagné and Doctor Merrill, each state their respective positions. These statements are fundamental to the other sessions an act as a springboard for sessions two, three and four. Now let's join the first session in progress."

Gagné: "In this first session, I have assumed that each presenter will give an account of his views on instructional design and that the response to that and questions discussion will follow both presentations. Then in a second session as Doctor Smellie as indicated we will try to say what the differences seem to be and see whether

they are simply semantic core or they are more deeply grounded. Well I've studied David Merrill's accounts on component display theory and I'm not sure I've learned it in all of its details. I see that it has some points that are virtually identical with what I have written about and others that seem to be based on contrary assumptions or contrary hypotheses. But then there's a large middle area too that may be a matter of difference in emphasis and I will come to that I hope in the second session and not in this one. So let me then speak about Gagne's ideas of the basis of instructional design. The first point is that to discover the conditions for learning. One needs to begin with the definition of the performance. Now that is what is it that's going to be the result of the learning. What performance is the individual learner going to be able to exhibit after he's learned? Now since these performances are all sorts very different there is a deep to search for common features and the common features are found not in the performances themselves but in there inferred internal organization. How much they be organized internally in order for these performances to occur, in order for these similarities in performances, these similar features of performance to appear. So this leads to a categories that I have talked about and by the way I refer you now to the handout call part one review of main points of Gagné conditions of learning and if you wish to a look at the things that are in that table the tables that follow, I think you'll see what I'm talking about. I'm not going to go all over these with you but I think you may find it possible to refer to these as I go along. So these categories that I talk about then, categories are of performance are as listed here in the left hand column of these tables; verbal information, intellectual skill, cognitive strategy, attitude and motor skills. Now I realize that we are not going to spend much time on attitudes and motor skills since these are not the main kind things that David Merrill deals with but I mention them they indicate that they are a part of five different outcomes of learning. Now the differences that occurring is it seems to me our differences in their organization. By that, I mean their internal organization the way they are stored in long-term memory. They are obviously different in terms of the observed responses, the observed performance itself, but one infers that they are different in how they are organized internally. This let me try to give you a description of each of this in those terms. Verbal information or sometimes called declarative knowledge an example being what is the first amendment say. I don't mean verbatim what is a first amendment say if someone has that kind of declarative knowledge or verbal information that's what I'm trying to talk about it. This kind of information is stored as networks of propositions that are linked through common concepts and probably also in terms of concept trees or hierarchies of concepts. Linkages are made more accessible or they are strengthened by repeated usage and

access for retrieval of these appears to be through what I call concept nodes; it is the verbal representations of the concepts that are represented. So, in other words, verbal information is stored as networks of propositions and these have some organization, too. The next category is intellectual skills. This is a second kind of performance. Intellectual skill also called procedural knowledge. What's an example; well let's say the procedure of dividing fractions. These are stored as linked procedural steps; each step being a concept node. This is not necessarily verbal and each step is what is called by psychologists a production that is if something is true then something is true. Each one of these is a production. The steps are arranged in hierarchies and not like verbal concept trees that I previously mentioned but these hierarchies are composed of skills; excuse me, procedures that are included within each other. They are what I call learning hierarchy form. The higher and more complex procedure includes a simpler, set of simpler ones. What we look at in performance is a course the execution of a procedure without hesitation and without error. A third kind of thing is called cognitive strategy. These are skills or procedures if you wish that influence and govern this selection and activation of other production systems that the individual has. They are as I said they are themselves procedures and they are at once general that is they are applied to a great many kinds of internal operations and they are usually simple. That's an important word. By simple, I mean they are such things as break the problem into parts. Surely, that's a simple idea. Breaking into the parts or work the problem backwards, that is simple. So that's what a cognitive strategy is. They are retrieved by some kind of cuing sometimes that's external but it can be internally generated. The more specific they are the more helpful they are. Contrast a very general strategy like work the problem backwards with let's say a troubleshooting strategy applicable to troubleshooting a series circuit which is first make a test that the point that splits the flow in half. That's much more specific you see. It only applies to the kinds of things that can be arranged in causal sequence which may have cost me in electrical circuits but may also mean the interactions of organ systems in the human body but that is not as nearly as general the course is the idea that you can have a general cognitive strategy which has worked the problem backwards. Okay, then just let me mention as I said I would the other two categories our motor skills what is an example on inserting a contact lens. It has been long recognized that these are stored as tightly organized motor programs composed of procedures which are called by some executive some routines but otherwise they're not accessible to verbal influences or cues. They can't be established by telling but only by practice of the movements themselves. Anyone of you would tried to tell somebody how to put in a contact lens realizes that you don't get very far by telling started alright and you can say well it's this is the this is the

procedure but that's about it. The performance is a smooth is a muscular movement with precise timing and the improvements in this go on for a long time can go on a long time. Okay, attitudes that the fifth kind, again I don't want to spend too much time on this but I think on demand in order to indicate its distinction from the others in terms of its internal organization which is what I'm trying to talk about. What is an attitude? Well, choosing to listen to classical music is an attitude. These are acquired mental states that when encountering certain cues in certain situations influence the choice of personal action which is I said let's say choosing the classical music. Other examples are what is one's attitude about disposing a personal trash, what they do about that or rejecting harmful drugs is an attitude that people are very much concerned with these days. Attitudes differ from other learning outcomes in that they appeared to incorporate models of human action. Along with other kinds of elements such as propositions and productions that I've already mentioned. All that makes very distinctive you see. They are virtually uninfluenced by verbal statements by themselves, persuasion by means of verbal statements has been found to be very ineffective. But if you have an admired human model involved that makes enormous difference. So a part of the storage of an attitude a part of the organization that this kind of performance has internally years as I think of it the human model. Now these five different kinds of human performance I have talked about all five now are so different from each other that I think one can readily infer that they do have different internal organizations and I've tried to indicate what I think those must be. Verbal information; well is different from intellectual skills and so on all true the five. These differences in performance and organizations imply differences in the conditions needed for learning. So let me briefly summarize those and I think perhaps you can begin to I don't know you can follow those on this chart very much but I'm trying to summarize these and let me do that. Verbal information; new verbal information is most readily learned when related to a complex or organized previously learned information. Otherwise learning can be aided by the use of distinguishing cues such as those provided by like say the special organization. Are you might present the this using the same example you might present this amendment by showing its parts say showing that it has various parts and one of them refers to the press one of them refers to the assembly one refers to religion and so on so that one might organized that in some kind of tabular form, mine might organize it in some kind of a special form in order to make these different parts distinctive. Okay, now we turn to intellectual skills and about their learning. New procedures new intellectual skills are most readily learned when the subordinate skills which compose them are readily accessible. That is it say if you really want to start with learning how to divide fractions then the subordinate parts of this, subordinate skills that are involved

in such as a recognition of the numerator and denominator and things like that and the operation of multiplication and the notion of inversion, all of those things you see are subordinate skills to the learning of the new skill of dividing fractions. If these are readily accessible then the learning of the new skill is relatively easy. Now these may have been previously learned, but in contrast to the diffuse nature of the previous learning for verbal information which is I pointed out might be in I general information about let's say the laws, religions so on. In some countries, these elements of prior learning are highly specific. The cues which helped the learning of intellectual skills are also quite specific. A refer to the ordering of steps in the procedure. So both cases there is a reason for calling upon prior learning, but the nature of that prior learning may be different in these two cases. Cognitive strategies since they are so structurally simple require only a little help from prior learning. Usually they can be conveyed to the learner by simple verbal statements, that is if you say to some start from the in work backwards what prior learning does the individual have to have, all here she has to know is what does backwards mean what does work mean and that's all. See so there isn't much there. Of course, practice with varied examples helps with learning as is true with other procedures I didn't necessarily mention that. Motor skills well here again recall of prior learning may help in acquiring the executive some routine that is the procedure that one does in motor skills. And is what you do first you pick up the lens between your fingers and then you the whole raised it up then the entire stack to steps in the procedures. The cues for learning, however in this case, and I think it's important to make this distinction even if we're not going to talk much about motor skills the cues for learning here must come primarily from the movements themselves which is why one has to practice motor skills. Okay, attitudes; well since their organization incorporates a model of human action learning must somehow require a human model. Recalling prior learning may help to determine the situations to which the performance applies. Now then, what I've said is that there are different categories of performance; five kinds. Each of which has a different internal organization and each of which for that reason requires a different set of learning conditions. In designing instruction, there are of course routine steps to be followed in arranging the stimulation to be given to the learner. I've called these the events of instruction. Alright in addition though I hope that the instructional designer will have firmly in mind the requirements that follow from consideration of these differences in performance and in the internal organizations that underlie them. End!"

Merrill: "That's it!"

Gagné: "Yes sir!"

Merrill: "I like to first express appreciation for all of you those who left the national soap opera, the interviewer Oliver North and came here and why you know that will be on CNN later tonight so you won't have to miss it. This is a great honor for me. I've said this in bob's presence before but I like to say again in front of you in that I've always had a great admiration for Bob Gagne and probably more than any other single scholar Bob is influenced my work. I remember as a young graduate student back more years to me probably the one to remember writing what was probably the first significant paper I ever wrote and I think it was titled "Different kinds of learning" and that this was about1964 and I presented that paper to a couple of my professors. One who thought it was interesting in the other who thought it was nonsense, because he was a basically an SR theorist, and I really thought that was great and in fact I was so intrigued that I decided I would write a book on the different kinds of learning and that I was raised as a scholar in a school which was very much behavioristic and SR psychology and somehow it seemed to me that was a very limited notion having spent several hundred years trying to explain complex behavior with SR bonds. I found that there must be something else in life and as a result I had written this paper which I thought was very insightful was shortly after that someone pointed out to me that there was a year man that had written a book called the conditions of learning. This was in 1965 and I had to take a look at that book and I immediately did shortly after it was released and lower behold here in excellent pros very well-researched and certainly far more insightful than I had been was exactly the point I was trying to make and that was Bob this first edition in the conditions of learning which became a very influential book. In fact I think at that point I began our first correspondent Bob I think I wrote him a letter and said it had written book I wanted to write and we became associates and friends ever since then. Since that time Bob set a great deal of influence. In fact that getting many times and said all I've ever really tried to do in my career was to say what he said or interpret what he said or what he should have said. We agree there's a few points of things that he should have said he may not agree that he should have said and will probably get into those in the second session. And so in a sense component display theory was really an attempt not to create an alternative theory but really started out in my teaching attempts to teach the conditions of learning to teachers and instructional designers and as I tried to explain what I thought about Gagne and said things stared to extend and extend presume I guess I got away from the text but nevertheless a result in some other ideas and I like to try to summarize those very briefly today. Most of what you have heard that Bob say I have

really no quarrel with. I basically buy the conditions of learning assumption which briefly stated is that there's different kinds of learning outcomes because different kinds of things learn differently that the conditions necessary to measure and to promote those different kinds of learning are different and so I definitely buy that kind of a category and I think it's important for those that are not aware that this is not everyone agrees with this point of view there are those who think there is only one kind of learning and that don't necessarily buy the conditions in category assumption but I definitely subscribe to that. In an attempt to do that however we found there was a little easier I thought and this is one the issues I suppose that will get into to describe it if I could I just step right over here and in the throesoverhead that most of these you have copies up but we attempted to try to describe a various kinds of content as well asvarious kinds of content as well as various kinds of outcomes. So the very first overlay which you have in your handout of part 1 is our attempt to what we call the performance content matrix. And rather than classifying things into five categories as Bob is indicated we tried to divide things in two dimensions; one dimension is the kind of Content involved which we in this version have talked about his facts concept procedures and principles and at the performance level we said that there's the remember instance that's remembering the specific case remembering generalities at the general case using a generality in a specific case and finding a new generality and that the intersection of these defines the various outcomes of learning. So in our case we probably have looks like there are thirteen on this particular diagram and it depends a little bit who the way you chop it up. So rather than saying there's five categories would really say there's thirteen but in very real sense there's a correspondence and in the second session will try to show you that this is not that different it's just we made some subdivisions that bob has not made but I don't think there's anything on here that's not on the five kinds. The big difference here is really the issue of content is content a separate category needed to be a separate category why should we do that and I suppose we may have some differences to discuss there. The other part that we tried to do is to get a little more specific when it comes to what it is that we present to the student and so we conjured up the term which we call primary presentation forms. My father is a landscape artist in early in my life I learned about the primary colors and I was always intrigued as a kid you could make say yellow and red and get orange in it you know your head have three crayons to get anything you want sort of and that I never did learn to do it very well but that notion to intrigue me and so I said there must be the same kind of a notion in other parts of life. There must be various kinds of primary presentations and if you mix these together you can get any kind of a presentation, and so we can shut up what we call the primary presentation forms which

are explained on this diagram slightly that is we use that kind of symbols and things to make it more intellectual. But when we talk about as an expository generality you're the presenting in the general case and expository instance are much more service will call an example at the specific case an inquisitorial generality asking the student to recall the general statement and an inquisitorial instances asking the student to apply the generality to a specific case or is often called practice and in fact this got reduced to and the ticket system rule example practices usually refer to by those terms. But when you want to be a lecture we talk about expository generalities because it sounds more esoteric. So, never the less what we argued was that all instruction be could compose of these. Therefore for me the conditions have learning one of the conditions was is that you get organized certain combinations of primary presentation forms and that the combination of primary presentation forms for each of those categories of outcome would be different in some way, and that's one of the differences in conditions and that the degree to which you arrange the right conditions would be the degree to which students with maximally learn from that material. If you use the wrong combination primary presentation forms, there will be a decrement performance, not that there would be no learning but there would be a decrement, and if you use the appropriate combination of primary presentation forms that you would get an increment in learning and that learning would be better, and that's one of the basic setup rules from my component display theory then really is what we call performance PPF consistency and I don't intend to go through this chart there's a reference in the materials to chapters and things where you can read explanations that this is certainly not time in our presentation today, but what we've tried in symbolic form what this table tries to do is to indicate that here the various kinds of performance remember use and findhere's presentation practice and performance kind of steps in instruction and here their appropriate combinations of primary presentation forms. And again the rules then are that the instructional design rules that there's a consistency between primary presentations and performance and the degree to which you meet that consistency in your instruction is one of the things that will contribute to instructional effectiveness. So that's the first set of rules and again it's an extension of the conditions notion that the conditions here though are being stated in terms of primary presentations and the categories being slightly different. A second idea and this is an idea that I think is not emphasized in bob's work and we talked a little bit about over breakfast this morning and I'm sure we get into a little in the second session is that it seems to me also that there's a correspondence between content but you've got facts concepts procedures and principles and the format of those primary presentations. While we have primary presentations of rule is not a rule is not a rule; that is a rule for a concept is quite

different than a rule for procedure or rules for principal. So one of the things we've tried to do in that theoretical presentation is to indicate what are the characteristics that a generality would have for a concept for the generality whether the characteristics that a generality would have for procedure and so forth the same for instance is either in expository or practice form and that we think that these characteristics are also important. So the second set of rules says the degree to which you have included the appropriate characteristics of those primary presentations for the particular content is the degree to which your instructional be affecting. Now all of these are so common sense their bases so what except until you pick up any textbook and I almost say this without fear of contradiction you pick up any textbook and find all kinds of inconsistencies you can find definitions and concepts when the really teaching procedures you can find statement of procedures and they're really trying to teach concepts you can find missing primary presentation forms and so forth. So I do was could we create a careful definition of these instructional components and the term by the way component display theory came from what are the components of instruction and our emphasis was on these display components the primary and secondary presentations and that's where the name comes from component display theory really is a theory about the component displays which comprise instructions so that's where the name came from. So the second part is a set of rules then that's an if you have a particular kind of a primary presentation for a particular kind of content than it has to have certain characteristics if it's to be optimally effective and that's what this chart kind of summarizes and again we don't have time to go into the details. We also identified the notion that there were secondary presentations. Secondary presentations are things that are not part of the content; things like attribute isolation or help or attention focusing devices. Bobbin his talk about making accused the screaming double, this is the idea; that's here and that we said that there are certain ways to do that. So one of the kinds of secondary presentations are the things you might add to focus the students' attention or to direct them as they learn the materials. We also talked about secondary presentations in terms of prerequisites. In Bob's work pre-record is a very important part of the whole idea and we sort of put prerequisites here in the notion of secondary presentations; that is if you're trying to define a particular concept but you want to remind the student what they already know about the attributes you don't need to go through a full-blown presentation of those things that are already learned but you do need to present a generality or an instance or practice problem to remind them and that we would also call a secondary presentation. The other type of secondary presentations really deal with things like context, historical facts, nice to know information; so there's at least three different categories of secondary presentations, and this chart tries to

prescribe those secondary presentations which really make a difference in learning outcome somethings like historical background so forth may not make a difference in terms of theperformance of the student unless of course you're checking performance on the remembering that historical background, but this then try to summarize the inclusion of secondary presentation. So we have again a little finer detail a way of describing the component displays of instruction. Finally there's a set of inner display relationships. It's not only the fact that you need a rule an example and practice but the relationship between those things makes a difference. For example oftentimes people said you need examples and non-examples, but our research has shown that non-examples presented without any relationship to the examples are not very useful; that is you don't learn much from finding out what something is not and less what it is not is carefully compared with what it is. So we introduce the notion of matching; that if you match an example and a non-example, then it carefully show to the student what attributes are relevant and what are not. So we felt like the concept of matching which is in inner display relationship is an important type of rule. We extend studied that extensively with concepts and but I would even be heretical the say that applies also to learning of procedures and principles, often you can gain a great deal by showing a student how not to do something. I remember on the early Apple computers yet to say be very careful because the RESET key is right up next to where you're always pressing the buttons I remember on the Apple who early Apple to computers you're always resetting your program because the reset key was right next to the return key something is really easy to slip and hit it. So what we found was very effective said don't do that, don't do that. If you emphasize what not to do that is the same form of matching an inappropriate procedures appropriate procedure. Same thing is true in learning principles. If you sometimes say that the student this is a common misconception, people oftentimes try to solve the problem this way, don't do it this way. You won't get the answer if you do it this way. You can prevent that so we would extend the matching notion not only to concepts but beyond the procedures and principles, and again this is a relationship between these primary presentations and secondary presentations. If you have an example you need a match non-example and it if you scramble those you lose that effectiveness and we've done several researches that is Bob tennis University of Minnesota's done lots of lots of research on teaching concepts where we've looked at scramble presentation forms versus carefully organized presentation forms where everything is exactly the same in the instruction except the organization and found it really does make a difference how things are related to one another and that's what we're dealing with here. Now, there are some other kinds of things that we dealt with and the idea of a variety of examples is divergent set of

examples, again is an important idea. The idea of transferring control which we've called here terminal program destruction term fading but fading is a very important idea. If you continue to provide help to a student right up to the time of the test students become very reliant on that help when we found that and ticket system where we had help available under learner control the students and we found that students if they had help available what often studied the problem for a few minutes then that punched the button and then go get the help and help with working to the promissory I got that. And they get to the test would help us develop on their performance with that commit considerably and they do very poorly and the reason is they became very dependent on the help. We did some studies where we took to help away from problem and then we found out they spend a lot more time studying the problem, and learning it for themselves and they did much better on the test and so ironically the help which we put in the system to facilitate the student actually turned out to be a debilitated if you don't get rid of it. So what you have to do is put help early on and then you get rid of this help later on is a very important notion of fading again a relationship between the displays and so we talked about these. There's a number of other things on here learner control get into I'm sure but one of the notions we had release them from my older son I remember when he was about the fifth grade he was getting very low grades in arithmetic and I said to him how come you getting low grades arithmetic in your high grades in everything else and he saw that have you ever heard of enrichment and I say I know what enrichment is a well- known which means that if I get all of the even problems right I have to do all the odd problems and he was doing the problems in his head right down the answers the other thing you have to do is to ride out all of his work so go to the book write the answer by every problem in his head then go back and laboriously for the next two hours copy down the problems and work backwards to figure out what all the steps related but on the paper to show the teacher and if you got them alright then she made into all the others and because the case was here he knew how to do it to begin with two problems would have been adequate we had to do fifty if you got them all right so he found the easiest way to do that was to get B's and not do all the problems we always leave the last three off and that waited never have to do the odd ones. Well that triggered in my mind the idea that students have a pretty good idea when they need more practice and so the notion of learner control of primary presentations not have the content to be learned necessarily but of the kind of presentations students know when you need to see another example you know when you need to see definition again you know when you need to practice another problem so we talked about the notion of learner control which became an important part of this. Now that's the end of part one and I want to do our part two this morning because this

is component display theory might one but I really want it because we're going to talk about this afternoon the relationship of instructional design the cognitive psychology and two artificial intelligence and some other things I want to really talk about component display theory too because I feel that there's some real weaknesses in the theory presented in a way this is not completely fair because I haven't written much about this so but I thought to make more interesting dialogue about the talk about things in no one knows about including me. So what I want to do is to present this is a model of what I think is involved in an instructional design system and this is obviously triggered from my work with CAI things where these components have to be very very explicit, I'm like live instruction where we can hide a lot of stuff it was really easy to prepare a lecture I say I start out by saying I have 50 minutes and I work backwards from there it becomes my objective to fill fifty minutes and then we can work you know whatever other objectives might fit in there. But in this case we're really trying to say our good how to what are the components that are necessary here and so we started out by saying I didn't want to start with behavioral objectives anymore because you want to deal with whole bodies of objectives and sometimes if you're learning something like solving linear equations you know it just have an objective you have bunches of objectives, so we use the term goals we learn use the term knowledge because this is kind of the current inaccurate subject matter you can substitute in their content if you want and student attributes are all things that you have to take into account in leading to what I think that the new thing instead of talking about components to talk about a factor concept for procedure. We want to now talk about content structures. We want to talk about taxonomies of concepts, we want to talk about a whole set of procedures; they're all relate together, we want to talk about the nesting of these structures within one another. And I'm just throwing things out a very broad way right now because this kind of an overview introduction later this afternoon we will try to get into a little more but it seems to me the first thing now is that a writing an objective. It is really to what in the butt from an actor's called knowledge acquisition is to acquire the knowledge of the subject matter in an organized way. Bob talked about procedural and structural knowledge is being organized. It seems to me if it is organized in part of a purposive instruction is to promote that organization, never going to promote that organization we need to have some idea about what it is to begin with and content structures are our way of representing it. So later on I want to talk about some cardinal principles of instruction; one of which is an extension of the basic Gagne assumption and that is that there are different kinds of cognitive structures and at the purposive instruction is to promote the development of the appropriate cognitive structure for a particular kind of outcome and one of the ways we think to do that is to

have an appropriate kind of content structure organization of the content to do that. So that we see is the first step. This is not something necessarily presented to the student but from a content structure well let the a represents a set of rules then that says how do you decide how to classify these things is the problem that Bob said, I've had how do you decide how to knowing the goals the knowledge in student attributes how do you decide how to classify that so that you know which content structure or content structures is most appropriate. The second set of rules as once I have got a content structure or structures instantiated and I know what all the pieces of the content are how I move from that to a course organization. I started to do some research on this literature about a year ago and I found that with all our work in Instructional Design there's very little written about course organization, what is a module, what are the contents of a module. These are kind of arbitrary terms everybody talks about lessons in modules in all of us know what they are but no one knows what they are. How do you decide what content goes into modules, are there rules for that, is that an art form. Bob and I had a conversation over breakfast one morning AECT and I asked him it is an art form. You know you make a judgment. Well since I've been working in artificial intelligence lately, art forms must break down into rules of somebody can do it then you gotta be able to figure out how they did it though we try to figure out what are the rules to get from content structure course organization. These are not part of the original component display theory but certainly are that important set of rules that I want to talk about later. A second idea is that what you gotta course organization these are not all linear. Oftentimes students can skip around in such an organization and that leads you to a set of sequence rules. How do you decide which module is next and when do you go to the next module and that becomes a set of sequence rules and those again or not treated very well upon display theory, Charles M. Reigeluth, and I did attempt to make some inroads here with I think call the elaboration theory which was an attempt to look at course organization but there's a lot more extension the needs to go there so that new component display theory really needs to deal with that strategy, sequence question as well. Now once you have these modules which are represented bythese little boxes it seems to be the module consists of a set of transactions and I need to extend that a little bit because the notion is that perhaps a primary presentation form is too narrow of an analysis. I liken it to atoms and molecules primary presentation forms are atoms but sometimes we need to talk about molecules we need to talk about combinations of primary presentation forms that introduce a whole set of interactions with a student. So for me a transaction and is this whole give-and-take that's necessary to present to give an idea or necessary to practice a given idea and I might consist of a whole series what we previously called primary

presentation forms. So one of the new notions we want introduce is the notion of a transaction. It's also possible that a given module which is a set of content now organized in some block to present to the student might be presented to the student in various ways. So you might have multiple transactions for a module which raises then the next question; how do you decide when the students through with a given transaction, especially these are open-ended transactions like exploring a simulation. How do you know when that's when he's had enough and to go on to something more directed or some kind of practice or something else. So the other question then really becomes a strategy question and really the sequence in strategy the same question. Sequence really deals with which modules next and windy a shift and strategy really deals with the question which transaction is next and windy a shift and so now we need a set of rules that says how do we translate content structure into content representation that is this is the content itself on which these transactions can interact. Now if you think about it in a way content representation is the database, a transaction is a window into that database for a given student which enable them to interact with that subject matter in a given way and that subject matter comes from this knowledge acquisition of the content structure. So inadequate instructional design theory really needs to say how I get from here to the knowledge representation, how do I get from here to the course organization and how do I get from the course organization to appropriate transactions. So instruction take on some new dimensions and I think some more detailed dimensions and those dimensions are yes there are different kinds of learning and big sets of these different kinds of learning are represented here by content structures and we can't present everything at once so you've gotta figure out a way to sequence this for student which comes down to modules and the sequencing of modules and you need gotta figure out a way for the student to interact with those which comes down to transactions and interfacing with this database. So the conditions are then that there are different kinds of content structures these correspond in some ways to different kinds of cognitive structures developed inside the student and that these different kind of which is completely consistent with the presentation Bob made this morning and that there are different kinds of transactions their different ways to sequence modules and that these ways are appropriate to the kind of structure that you try to develop and the kind a contents structure that represents this. So it's the same basic idea but we're now stretching it to deal with more complex bodies of information and more complex definition of what we think the transactions are. Now display sort of becomes a problem component display theory becomes a problem because displays are these little pieces of things and now we're talking about transactions and modules so we changed

the name to component design theory so we can keep the initials but they were displayed in same to work so we still have components but we don't have display so much anymore so you know it's not talk about CDT so we want to confuse people for a long time to come so that's why that. Now let me just give you a couple of other things and wrapping up. This is the new performance content matrix, the old one is buried here you see facts concepts procedures principles remember years and find but we now substituted some other terms consistent with what bob said this morning I also believe that cognitive organization is organized around declarative knowledge procedural knowledge and cognitive strategies and I like his definition so I'm going to call it that. The difference is that I think that his daughter Ellen Gagne add a greats book called The cognitive know it with it's a school early cognitive psychology in school learning I think which is a very good summary of the current cognitive psychology especially to work of John Anderson, and some people Carnegie Mellon, and its application to education. And she makes two points about declarative knowledge, elaboration an organization are two things that tend to promote the development of learning related to these well it seems to me if that's the case then rather than leaving that up to the student as an instructional designer there must be a particular organizations which are most appropriate for particular outcomes. This is an attempt to try to identify what we think some of those are and again it's an extension of our previous ideas in that facts course by basically the list and list can be broken down into haphazard a random list that is an organization an ordered list; such as chronology ordered on size or color or something else. Concepts kind a break down into taxonomies of which there are several varieties kinds of taxonomies, there are five kinds of dogs or something. Parts of taxonomy; this can be divided into the following parts. Properties of taxonomies, functions of taxonomies. So these various ways you can create three structures of organization. There are also the thing we call procedures before which here we use the term algorithm and there's two main varieties of these are decision algorithms which deal if this then this if this than this kind a decision trees and there are also what we call path algorithms it says do this do this now branch do this do this do this so forth. And finally the other well I miss my bow this term from Alan Collins causal nets, these are these are kind of why did the things happen and we can talk about a bit chains and causal chains and event chain is something like a the life cycle of a butterfly you know it's the Chris cella stage doesn't cause the thing to become a butterfly but this happens first person to larva then it spins a web a round itself and then it turns into a butterfly net lays eggs and as a Marvin you have this cycle that's kind of the event chain causal chains are the kind of thing that says if this that it causes this to happen and these are some kinds of explanation kinds of things well these it seemed to me all represent

variations of these ways we store information and these also represent then variations in the way that we can organize content and that we need to organize that content appropriate to these organizational structures and build our instruction from those content structures. I think that I'm two minutes okay I have but two slides that's good you went one minute each. I briefly here tried to summarize the difference between component display theory and component design theory. In component display theory we have classification of objectives on a performance content matrix we're extending that the classification goals subject matters students' characteristics on content cognitive structure matrix, bigger units of analysis. The course organization here was elaboration theory here we're talking about module selection specification module sequence selection and specification which is a little extension of elaboration theory. Here we talked about primary presentation form consistency, content presentation form consistency, secondary presentations, inner display relationships, here we're talking about transaction selection specification which subsumes all of these things, but really has some more things in addition and finally we have a learner control but now we're talking about strategy selection in terms of both learner and system control which would come to call adviser strategies. So, there's an extension here we're trying to move toward a more global kind of picture. Finally this slide I think kind of a summarizes, this kind a new idea like to get across. That is component display theory had a Micro Focus, the focus was on lesson segments for teaching an individual concept on individual principal. The new component design theory has a macro micro focus, it focuses on courses and modules not just the individual pieces but it also doesn't neglect the pieces. I use the analogy displays the Adams transaction is the molecule we're talking moving from this place to transactions. We're talking moving from individual objectives to content structures which might incorporate many objectives. We're moving from primary presentation forms to transactions we're learning from moving from learner control to advisers' strategies which involve the next module next transaction. Well now you know everything I know. I tried to summarize very quickly component display theory exists in the literature and component design theory as we're now thinking about it and as we're moving to it in a way to kind of present an overall picture and in the next session I will try to move to some discussion at the differences that Bob and I see."